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Student price index - a
project for high school statistics
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THE STUDENT PRICE INDEX
A PROJECT FOR HIGH SCHOOL
STATISTICS TEACHING

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THE STUDENT PRICE INDEX
A PROJECT FOR HIGH SCHOOL

STATISTICS TEACHING

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Statistics is becoming an increasingly important part of the high school curriculum. Whether as a separate course, or as a section of mathematics, statistics is being introduced to the student in some cases as early as in elementary school. Given the importance and the frequency of usage of statistical data in our present-day society, the student needs to emerge from high school equipped with at least some basic knowledge of statistical concepts.

The student, however, tends to find statistics and its related concepts and methodologies rather abstract. This is caused in large part by the student not being able to relate the material learned to reality. A quick perusal through many mathematics/statistics texts and teachers' guides reveals that the examples and problems presented are not especially conducive to enthusiastic learning. Raw test scores and tide levels are frequently used in texts - the student usually finds these boring and foreign to him/her. Since the examples are meaningless, the application of concepts and procedures is difficult for the student to visualize in a real situation.

This presents a tremendous challenge for teachers and educators to develop techniques and explanations that will be real and interesting to the student, and thus enhance his/her liking for statistics.

There is great potential in the study of statistics to create a high level of interest and involvement among students. Of the two basic types of statistics taught at the secondary level, inferential and descriptive, students tend to prefer the inferential type. However, descriptive statistics are an integral part of the subject as a whole, and as such must be included. A carefully designed blend of inferential and descriptive statistics will subtly interject the descriptive side of the subject into the more popular inferential part. Thus the students are exposed to both in the most favorable manner.

Certainly one of the best ways to develop an early appreciation and understanding of statistics is not only to introduce their operational side, but to involve students in the collection of data as well.

Young people enjoy providing information about themselves and finding out facts about their peers. An interesting and multi-faceted classroom project is to create a Student Price Index along the lines of the Consumer Price Index, a leading national indicator. Similar to the Consumer Price Index, the Student Price Index is designed to measure the increase over time in the prices of commodities that are of particular importance to the student consumer.

The statistical concepts and methodologies that can be applied to this project are limitless. Students are exposed to data collection, questionnaires, analysis, and evaluation. There is a great requirement for systematization and organization of work, and for executing a large number of simple statistical procedures and calculations. The teaching of quality of data and reliability are implicit to the project, as are indexing and time-series concepts. The exercise can also include distributions, regressions, correlations, chi square, and other topics. The project also provides for a cohesive approach to a single project, with several stages to be carried out over an entire school term.

A logical concern to teachers is whether or not a student can provide accurate information about his/her own expenditures, and whether or not in doing so he/she has sufficient interest to provide valid data. In the former case the student should be able to recall major expenditures that have taken place over the year. Purchases of a more frequent and routine nature can be easily recalled for a one-month period, and multiplied by twelve. In the Student Expenditure Survey a section on income, both during the school term and in summer, is included in order to assist respondents to recall jobs they held, money saved, and goals to purchase certain desired items.

Parents also should be helpful in reminding students about the disposition of their income. However, caution should be exercised to ensure that students report only purchases actually made by themselves.

Most, if not all, teenagers have a certain amount of disposable income, and the rise in prices and accompanying erosion of the purchasing power of the dollar is of concern to them. If a child's allowance is not increased in the face of rising prices, or if the price of some elusive stereo equipment increases faster than the student generates income, the child is affected. A Student Price Index assists the class in conceptualizing in simple terms the movement of prices, the workings of the market, and something about the nation's economy!

From the methodology which follows, it may appear that the project is very time-consuming. It need not be so. The following time allotment is suggested.

<u>Activity</u>	<u>Number of 50-minute classes</u>
Introduction to the project and discussion of the Student Expenditure Survey	ONE
Student Expenditure Survey	Homework to complete individual surveys, plus one class.
Evaluation and examination of questionnaires	ONE
Basket Selection table and Weights table	TWO
Standardization descriptions, pricing methodology	ONE plus homework
Pricing	ONE
Indexing	ONE

(continued)

<u>Activity</u>	<u>Number of 50-minute classes</u>
Monthly pricing of items in stores and creation of monthly index	Pricing - homework ONE/MONTH

This is a skeleton amount of time required to conduct the project. A teacher who includes a wide range of statistical methods and techniques will find, of course, that the time requirement increases.

The advantage of this as a long-term project is that it is not particularly time consuming. Yet it gives students a project with an element of continuity, and encourages them to view statistics as a normal and integral part of life.

When the class has created a six month time series of price data and calculated indexes, what do the results mean to them? They mean that the student may wish to try to solicit an increase in his/her allowance from parents. They mean that the student may have erroneously accused the cafeteria manager of raising prices every month. They mean that it is becoming more expensive every month to ski. They mean a great number of things, and the student will in all probability be very enthusiastic about providing his/her own analysis of the price data and their ramifications for himself/herself.

Methodology for creating the Student Price Index in the Classroom

At the start of the school year, conduct a "Student Expenditure Survey" (see Appendix) to collect information on where students spend their money and what commodities are of most importance to them in terms of expenditures. The survey, carried out by the students themselves, does not require name or address and thus protects the anonymity of the respondents reassuring any student who is reluctant to disclose his/her finances that his/her identity will not be linked to his/her answers, nor will the retail establishments where he/she shops be revealed.

The questions in the first part of the survey are designed to glean some background information about the respondents - for example, age, sex, employment situation. These data are useful to precipitate thinking along the lines of monies coming in, and those going out. They also can be used for later class analysis. A "nature of work" sheet generated by the class makes recollection easier - it would include babysitting, lawn mowing, waiting tables, and other popular student jobs. The student should include in the "other income" section such monies as allowance from parents, money gifts, etc. Data on income are not necessary for the actual construction of the price index, but they are very useful in recalling expenditures as well as in putting the exercise in perspective for the students.

The "Student Expenditures" part of the survey attempts to include the most popular items commonly purchased by the student consumer. The class may suggest other items to be added to the list - they should be encouraged to do so. In designing the Student Expenditure Survey the author did not attempt to include all items purchased by the student population. The survey contains a selection of those items considered to be the most frequently purchased (i.e. food), and most interesting to students (recreation, music, sports), plus an "others" category to allow for the inclusion of items important to students that have not been listed.

While it is virtually impossible to recall yearly expenditures on certain items - food in particular - it should be relatively simple for the student to recall expenditures on these items for a one-month period. These figures would be multiplied by twelve to obtain annual expenditures. When an item (or items) is frequently purchased by a student but has not been included in the questionnaire, the student should use the "other" category to report the item. Information on location of purchase is important for a later step, and students should be encouraged to complete this column as accurately as possible.

The class now examines the results of the Student Expenditure portion of the survey. Spending patterns will likely be different in some respects, and should precipitate lively class discussion. Quality and reliability of data should be introduced for discussion at this point. A "basket" of goods and services - not more than twenty - should be chosen from the expenditures section. The twenty items should represent those most important to (in terms of proportion of income spent) and most frequently purchased by the class as a whole.

The class should generate from the completed questionnaires a table showing the number of students that purchase each item, and the total amount spent by all students on each item. The percentage of students that buy each item should be calculated, as well as the expenditure per item as a percentage of total expenditure.

Let us look at the section on "Food at School" to determine how the "basket" should be selected. Assume there are 35 students in the class.

BASKET SELECTION TABLE

Food at School

(School year 1979-80)

Class 12G - 35 Students

Food item	# of students who purchased the item during the year	% of total # of students	student expenditure on each item during the year	expenditure on item as a % of total expenditure
Soup	4	11%	\$194.40	3.0%
Sandwiches	23	66%	1614.60	24.8%
Hamburgers	31	89%	2343.60	36.0%
Milk	28	80%	1058.40	16.3%
Soft Drinks	30	86%	1296.00	19.9%
Total expenditure on "Food at School"				6507.00
				100%

Note: For illustration purposes the author has calculated the last column (expenditure on each item as a percentage of total expenditure) using total expenditure on food at school instead of total expenditure - in the classroom the total expenditure figure would be calculated by summing the "Total Expenditures" category on page V of each questionnaire. Examples throughout this paper follow the same pattern.

Create a table such as this to include each item on the questionnaire. Look at each item and at its importance in terms of both percentage of students that purchase it as well as the proportion of total expenditure it represents. Only twenty items are to be selected. Those that are chosen should represent commodities popular with students, and significant in terms of total monies spent by the class.

In the Basket Selection Table, only four students, or 11%, purchase soup, representing an expenditure of only 3% of total food expenditure. Soup would likely be excluded from the basket we select. The students themselves will have to interpret the results from this table, and decide which twenty items are the most appropriate for inclusion. Consideration must be given to the facility with which a given item can be priced, the seasonality of an item and whether an item is a shortlived fad.

The next step is to determine the weight or importance of each of the twenty selected items - that is, to define the proportion of total expenditure spent on each item in the basket. Return to the example of Food at School, this time eliminating soup.

WEIGHTS TABLE

Food at School

Food item	amount spent by students	Expenditure on each item as a % of total expenditure	Weights
Sandwiches	\$ 1614.60	26%	26
Hamburgers	2343.60	37%	37
Milk	1058.40	17%	17
Soft Drinks	1296.00	20%	20

Total expenditure \$ 6312.60
for food at
school

In this table use only the twenty items chosen to be included in the basket. The "total expenditures" figure then becomes the sum of expenditures on the twenty selected items. The percent of total expenditure spent on each item is the importance or weight of that item. Create a weights table for the "basket".

Pricing of the twenty items in the basket is the next step. For each of the twenty selected items, a description should be made.
For example:

<p style="text-align: center;"><u>HAMBURGER</u></p> <p>1/4 pound meat bun, toasted lettuce tomato onion condiments (ketchup, mustard, pickles, relish)</p>
--

This is to standardize the quality of items to be priced, and to ensure that identical or equivalent items are priced each month. It is important to price the same item each time prices are recorded. If the price of a hamburger increases by ten cents, but a slice of cheese has been added, there is not a true ten cent increase, since the quality has also changed. In pricing a commodity such as a stereo record, the description "one of the top ten selling albums" might be included to ensure that consistency in quality and value is maintained.

From the "Location of Purchase" section of the Survey, the class should have no difficulty in selecting the stores and facilities normally patronized by students, and a selection of the most popular outlets should be made - perhaps eight or ten. A list of stores should be prepared. Each student should be assigned responsibility for pricing a few commodities in one or two outlets. When students collect prices they would then visit the same store each time, and to ensure quality standardization, each student should price the same items every month - the student assigned to collecting prices in the record store, for example would thus be responsible for ensuring that he/she was pricing the same quality record as he/she priced the previous month. Pricing can then begin, and should take place once a month at the same time (i.e. on the first Monday and Tuesday of each month). Optimally, several price quotations should be obtained on each item (that is, hamburgers should be priced in several different popular stores). Each month's prices for an item for all outlets should be averaged to obtain a single average price per item per month. There will, however, be cases, particularly in small centres, where only one outlet will carry a particular item (for example, stereo records). In this case only the one price quotation will be used.

Students should actually visit stores to collect prices, and should include in their prices sales tax where it applies. When an item is on sale, or presented as an advertised special, the reduced price is used, providing there is sufficient quantity of the sale item to make it widely available. A pricing chart is helpful in organizing price collection.

Price (tax included)

Item	Location	Month 1	Month 2	Month 3	---	Month 12
Stereo record albums	The Music Man	7.72	7.97	7.69		8.50
	Fishers	7.49	7.69	7.99		8.79
	Tune Town	7.29	7.59	7.99		8.49
	Average price	7.50	7.75	7.89		8.59
8-track tapes	Tune Town	9.45	9.45	9.59		10.25

Indexing the prices is the next step. The teacher here has an opportunity to introduce the concept of indexing, and to explain to the students the rationale behind using indexing in this project. If a stereo record costs \$7.50 the first month pricing takes place - i.e. the base month - the base value of 100 is assigned to that price. Calculations of indexes for subsequent months should be made along the lines of the following:

Stereo Records

Month	Average Price	Percent increase in price from month 1	Index
1	7.50		100
2	7.75	3.3%	103.3
3	7.89	5.2%	105.2
4	7.99	6.5%	106.5
5	8.19	9.2%	109.2

After pricing for five months the price of stereo records is 9.2% higher than at the beginning of the period. Similar indexes are calculated for each of the other commodities in a similar fashion.

The twenty individual price indexes for the twenty selected commodities can then be averaged into an all-items Student Price Index.

Suppose after pricing for five months, the following indexes result.

Items	Index month 5 Base = 100	Weight	Weights multiplied by indexes
Sandwiches	109.1	26	2836.6
Hamburgers	118.3	37	4377.1
Milk	103.5	17	1759.5
Soft Drinks	107.4	20	<u>2148.0</u>
			11121.2

All items index = 11,121.2 divided by 100 (reference period = 100)
= 111.2

Thus the students can create an index that represents the change in the cost of the selected group of student-purchased items over a specific time period.

Summary

This project was presented to and discussed with a number of secondary school students, with very positive results. Suddenly numbers became exciting, as the students became involved in an activity that was real, personal and meaningful. Instead of sitting at a desk, the students were learning while visiting stores, reflecting on their own finances and discussing the project with others.

A subtle form of learning experience took place - the students understood the front page newspaper article on inflation - they have been exposed to economics, as well!

It is the responsibility of educators to make learning as exciting and interesting as possible to their pupils. Through projects such as this that aim may be achieved.

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STUDENT EXPENDITURE

SURVEY

AGE _____

SEX _____

GRADE _____

SCHOOL TERM

DO YOU HAVE A PAYING JOB OR JOBS?

YES NO

AVERAGE NUMBER OF HOURS WORKED PER WEEK _____

NATURE OF WORK _____

AVERAGE INCOME PER WEEK (FROM JOB) _____

OTHER SOURCES OF INCOME _____

AVERAGE INCOME PER WEEK FROM OTHER SOURCES _____

TOTAL INCOME DURING SCHOOL TERM _____

(TIME PERIOD _____)

SUMMER

LAST SUMMER,
DID YOU WORK...

FULL TIME _____

PART TIME _____

OCCASIONALLY _____

AVERAGE NUMBER OF HOURS WORKED PER WEEK _____

AVERAGE WEEKLY INCOME FROM JOB(S) _____

OTHER SOURCES OF INCOME _____

AVERAGE WEEKLY INCOME FROM OTHER SOURCES _____

TOTAL SUMMER INCOME _____

(TIME PERIOD _____)

TOTAL INCOME (SCHOOL TERM AND SUMMER) _____

STUDENT EXPENDITURES FROM MARCH 1978-MARCH 1979

(FOR ITEMS LIKE FOOD, OTHER REGULAR EXPENDITURES, ESTIMATE YOUR EXPENDITURE OVER THE PAST MONTH AND MULTIPLY THIS BY 12 TO OBTAIN A FIGURE FOR THE WHOLE YEAR.* TRY TO RECALL ALL MAJOR EXPENDITURES AND INCLUDE IN "OTHERS" THOSE NOT COVERED IN THE LISTINGS)

PLEASE INCLUDE ONLY THE ITEMS YOU PAID FOR

TOTAL PRICE SHOULD INCLUDE SALES TAX WHERE APPLICABLE.

(1) FREQUENCY OF PURCHASE	(2) AVERAGE PRICE	(3)=(1) & (2) TOTAL EX- PENDITURE	LOCATION OF PURCHASE
FOOD AT SCHOOL			
- SOUP	_____	_____	_____
- SANDWICHES	_____	_____	_____
- HAMBURGERS	_____	_____	_____
- MILK	_____	_____	_____
- SOFT DRINKS	_____	_____	_____
- OTHER (SPECIFY)	_____	_____	_____
BETWEEN - MEAL FOOD			
- ICE CREAM	_____	_____	_____
- POTATO CHIPS	_____	_____	_____
- CHOCOLATE BARS	_____	_____	_____
- SOFT DRINKS	_____	_____	_____
- GUM	_____	_____	_____
- OTHER (SPECIFY)	_____	_____	_____
RESTAURANT MEALS			
- HOT DOGS	_____	_____	_____
- HAMBURGERS	_____	_____	_____
- FRENCH FRIES	_____	_____	_____
- PIZZA	_____	_____	_____
- CHICKEN	_____	_____	_____
- OTHER (SPECIFY)	_____	_____	_____

(INCLUDE HERE ONLY IF THEY CONSTITUTED A MEAL - IF NOT, THEY SHOULD BE INCLUDED WITH BETWEEN-MEAL FOOD)

*For the "Food at school" section, monthly expenditure would be multiplied by 10, not 12, as there are only 10 months in the school year.

(1) (2) (3) = (1)
& (2)

FREQUENCY OF PURCHASE	AVERAGE PRICE	TOTAL EX- PENDITURE	LOCATION OF PURCHASE
AN THREE ITEMS)			

TOTAL FOOD EXPENDITURES

RECREATION EXPENSES

(1) (2) (3) = (1)
& (2)

- MOVIES

RECORDS

- SINGLES
- ALBUMS
- TAPES

EQUIPMENT

- RADIOS
- TAPE DECKS
- RECORD PLAYERS
- STEREO SETS

ATTENDANCE AT

- DISCOS
- DANCES
- SPECTATORS SPORTS:
 - HOCKEY GAMES
 - FOOTBALL GAMES

4

(1)

(2)

$$(3) = (1) \\ \& (2)$$

PARTICIPATION IN SPORTS EVENTS

- SKIING
- SWIMMING
- TENNIS

RECREATION EQUIPMENT

- SKIS
- SKI BOOTS
- TENNIS RACKETS
- BICYCLES
- SKATES
- OTHER (SPECIFY)

OTHER RECREATION AND
ENTERTAINMENT EXPENSES
(SPECIFY)

TOTAL EXPENDITURES

1.8
30/9/87

